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ASPECTS OF THE FLUID DYNAMICS OF CIGARET SMOKE FILTRATION.

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ABSTRACT

The first part of this discussion reviews the physics of critical Reynolds numbers. The Navier-Stokes equations for fluid dynamics are used to introduce a discussion of the statistical character of turbulent fluid flow. The concept of turbulence of different "scales" is introduced. The critical Reynolds number for flows around obstacles in open, porous beds such as cigaret filler is discussed in terms of data available in the literature. It is suggested that this number lies between 10 and 200, with the probability of a value substantially smaller. Simple calculations are shown which indicate that the flow during a typical cigaret puff lies in the indicated range and may contain, therefore, a substantial unstable turbulent component. This component is suggested as being contained in the free stream entering the cigaret filter. The consequences of the free stream turbulence in the filter are discussed with specific reference to the movement of smoke aerosols towards filter components. It is shown that "micro" turbulence produces a "macro-Brownian" type of motion which is formally analogous to that proposed by Langmuir as governing the filtration of toxic smokes by gas masks. The state of the fluid flow envisioned by Langmuir is contrasted with that presently envisioned as occurring in the cigarette filter.

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